

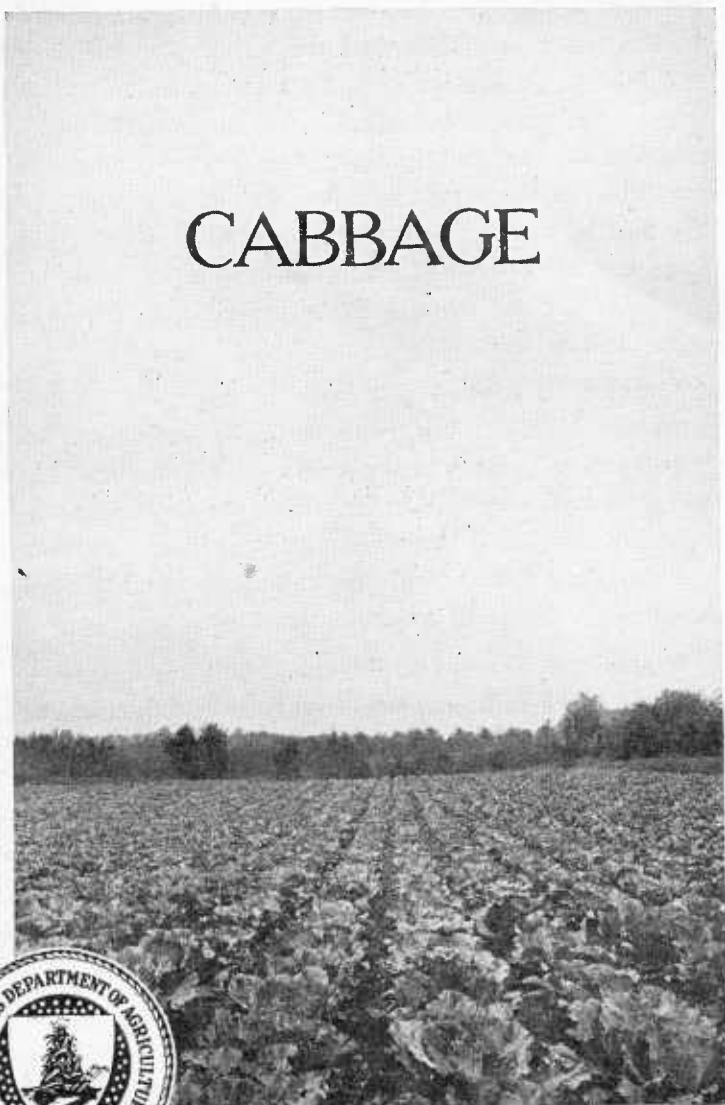
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# U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 433

## CABBAGE



**F**ROM A FOOD STANDPOINT cabbage is one of the most valuable and useful of the culinary vegetables. Varieties suited to the season and to widely varying soil and climatic conditions make cabbage a year-round vegetable. Fresh cabbage is available in the markets every day of the year. In the North, where the growing season is short, cabbage can be produced and stored so as to make it available for use when fresh supplies from the field are not to be had.

Cabbage is a crop grown in nearly every home garden. All market gardeners make liberal use of it and truck farmers in the South grow it extensively for shipment to northern markets, while the northern farmers grow large acreages for the manufacture of sauerkraut and for storage and shipment later to the city and southern markets.

High yields depend on the use of suitable varieties, well enriched soil, proper cultivation, and the control of insects and diseases.

# CABBAGE.

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## INTRODUCTION.

CABBAGE is one of the most universally cultivated of our garden plants. Although it is one of the leafy vegetables it finds a place in the home garden as well as in the market garden and truck farm. In some sections of the United States cabbage is extensively grown as a farm crop.

On account of its high mineral salt and vitamin content, especially when used in the unbleached state, cabbage is one of the most valuable of our green vegetables. No adequate estimate can be placed on the value of this crop, as it fluctuates very decidedly, both in acreage and in price, from year to year.

Cabbage culture naturally falls under two heads: (1) The truck crop of the South and the early market-garden crop of the North, both based on early-maturing sorts, and (2) the autumn crop of the farm and gardens of the North, based on the more robust-growing varieties classed as late cabbage.

Early cabbage is practically all consumed as a green vegetable. The late crop, on the other hand, is handled as a fresh vegetable, as a storage crop, and for the manufacture of sauerkraut. Cabbage is always in demand, and under present conditions it is always available, either as the product of a southern truck farm or a northern farm, garden, or storage house.

The group of cultivated plants which has been derived from the wild cabbage presents a greater diversity of form than that derived from any other single ancestral type.

Wild cabbage is a robust-growing broad-leaved plant enjoying the low, moist areas near the seacoast of southern Europe. The most closely allied form now in cultivation is the collard. The wide variation in the group is illustrated by the diversity of form shown in collards, kale, tree cabbage, marrow kale, cauliflower, and Brussels sprouts. It is almost beyond the bounds of reason to believe that all these forms have been derived from a common parentage, yet such is the fact.

## CABBAGE AS A TRUCK CROP.

### INFLUENCE OF CLIMATE.

The cultivation of cabbage as a truck crop at the South is so different from its culture at the North that this industry is one of the most interesting of the truck-crop group.

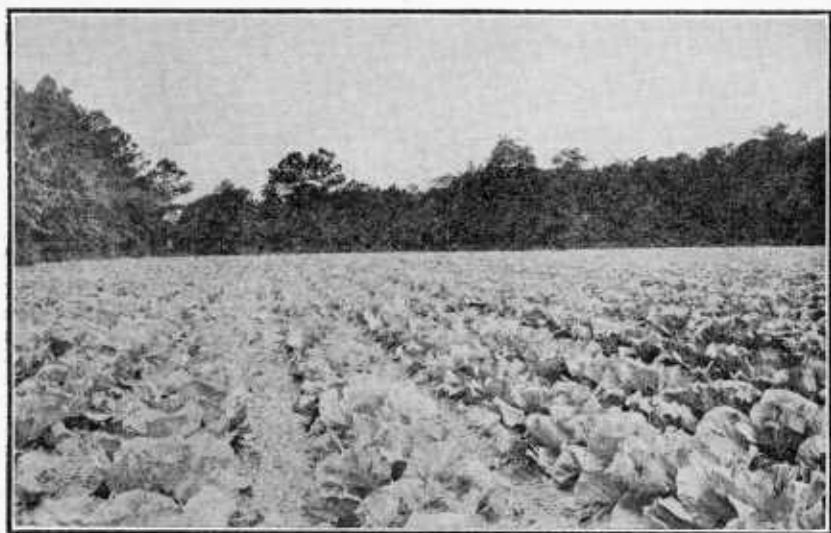


FIG. 1.—A good field of early cabbage in the trucking section.

The winters of the Atlantic seaboard from Baltimore southward are comparatively mild. Cabbage grown from seed sown in September and transplanted to the open in December can be successfully carried through the winter by planting it on the side of a ridge so as to protect it from the prevailing winds. The ridge should be at right angles to the direction of the prevailing winds, if possible, unless this would necessitate placing the plants on the north side of the ridge.

The dates of seed sowing and transplanting to the field, the direction of the ridges, and the position of the plants on the ridge are varied to conform to the conditions in the various localities. Near Baltimore, for instance, it is imperative that the plants be set the last of November on the side of the ridge, while in the Charleston district of South Carolina the planting season is later (early in December) and the plants may be set on top of the ridge instead of on the side.

Most varieties of cabbage are hardy enough to live through the winter and at the same time make considerable root growth. Cabbage which has safely passed the winter under such conditions is prepared to make rapid growth on the arrival of congenial weather in the spring. As a result, cabbage so handled is ready for market early in the season, as is indicated by Figure 1.

#### SOIL.

While cabbage will thrive upon a wide diversity of soil types, the soil which is usually selected for truck-farm operations is what gardeners call a "quick soil"—one composed of sand with a small percentage of clay. Much of the soil of the important trucking region of the Atlantic seaboard consists of the type denominated "Norfolk sand" or "Norfolk sandy loam." This soil can not be said to be ideal for cabbage, but suits it better than would the more retentive soils because of the season at which the crop is desired. Quick growth and development is a prime requirement in all truck-farming operations. Sandy soils, because they contribute to this end and because they can be cultivated at a season when it would be impossible to handle heavy soils, are almost universally chosen for truck-farming operations.

#### FERTILIZERS.

The soil for cabbage should, if possible, be an area upon which a green crop or a liberal application of stable manure can be turned under previous to planting in the fall. If fertilizers are used at planting time they should carry normal quantities of phosphoric acid and potash, but only a small percentage of nitrogen. There are two reasons for this: (1) A slow vegetative growth is desired at this season in order that the plant may be prepared to withstand the most trying period of the winter; (2) nitrogen, if applied liberally when the plant is small, will, because of its solubility, be lost, as the plant will not be able to use it as fast as it becomes available. Then, too, a liberal amount of nitrogen available at this period would induce a rapid, succulent growth which would make the plants tender and unfit them for passing the severe weather of the winter.

A satisfactory fertilizer for the planting season will carry  $1\frac{1}{2}$  or 2 per cent of nitrogen, 6 to 8 per cent of phosphoric acid, and about 10 per cent of potash. This fertilizer should be scattered broadcast over the area at the rate of 1,000 to 1,500 pounds per acre.

At the approach of the growing season the development of the cabbage should be stimulated by applying a side dressing of 150 to 200 pounds of a fertilizer carrying a high percentage of nitrate of soda or sulphate of ammonia with little or no phosphoric acid or potash in it.

Experience has proved that it is best to induce only a moderate growth in the cabbage immediately after planting, so that the leaves shall be firm and tough to resist any severe changes of temperature which may occur during the winter months. The nitrogenous fertilizer, therefore, is largely eliminated from the application made at planting time and reserved until the opening of the true growing season, which will vary in different localities according to the latitude in which the work is being conducted.

While this plan of applying the fertilizer to the growing crop is of utmost importance, it should not be forgotten that potash is the important element in a fertilizer for cabbage.

#### SEED.

In no truck crop does the character of the seed count for more than in cabbage. It is very essential that the crop come to marketable maturity early, that the heads be uniform in size and character, and that they mature so that the whole crop can be harvested at two cuttings. The small saving made by the purchase of cheap or inferior seed is usually paid for a hundred times over in the lessened value of the crop. A grower can not afford to risk his crop for so small a saving. The best seed that can be obtained is none too good, and anything short of this is not good business. Without highly viable seed of a good strain, true to type, the best results can not be expected.

#### THE CROP IN THE SEED BED.

Cabbage plants for a truck crop are grown in large beds prepared in the open field. The seed beds should be prepared in a new place each year. The area should be one on which neither a crop nor a seed bed of cabbage has been grown for six or seven years, to safeguard the plants against disease. The seed is usually sown broadcast or in close drills in late September or early October, in order that the growing plants may be available for transplanting to the field during the last half of November or in early December, according to the location in which the work is being carried on. The seed should be sown thinly, so as to insure stocky plants.

In some localities the production of plants for transplanting purposes is an important commercial industry. A few growers in the neighborhood of Charleston, S. C., conduct a business which enables them to supply plants for transplanting purposes in carload lots. Under ordinary conditions, however, the plants for transplanting are grown by the trucker and transferred directly from the seed bed to the field.

Under normal conditions one-fourth of a pound of seed in the seed bed will supply plants for setting an acre in the field.

#### TRANSPLANTING TO THE FIELD.

At the time of setting the plants in the field, if transplanted by hand, they should be lifted, puddled, set with a dibble, and firmed by a second thrust of the dibble. If set by a transplanting machine the soil will be firmed by the compression wheels or firming blades of the machine. The usual practice throughout the southern trucking areas is to throw up ridges at right angles to the prevailing winds, which usually means that ridges are made east and west, and on the south side of these ridges, about a third of the distance from the base to the top, the cabbage plants are set 13 to 18 inches apart. If at the time of transplanting the weather is warm and evaporation is rapid it is advisable to prune off about half the leaf area of the plants in order that evaporation may be diminished and the plant receive less check than it otherwise would.

## CULTIVATION.

At the season of the year following transplanting, little cultivation will be necessary, as weeds will grow slowly if at all.

Cultivation can therefore be deferred until the active growing period in the spring. Care should be taken, however, to prevent weed growth which shall in any way interfere with the development of the young cabbage plants. After the side dressing of fertilizer in the spring, cultivation will tend to bring the soil to a more nearly level condition.

The side dressing of fertilizer is applied, as shown in Figure 2, to each alternate "middle," and the distributors are so constructed that the fertilizer is applied to two rows of plants at one operation.



FIG. 2.—A field of cabbage, showing the spring application of fertilizer to each alternate "middle."

## ENEMIES.

In the trucking region important enemies of the cabbage are the harlequin cabbage bug, which sometimes causes considerable damage to the plant beds in the fall; the cabbage worms, which in some instances cause considerable loss; and the cabbage "louse."

**The harlequin cabbage bug.**—The most effective means of controlling the harlequin cabbage bug are: (1) Careful cultural methods, which must be interpreted to mean not only good cultivation but the gathering and removal of all cabbage refuse from the field in the autumn; (2) the use of trap or decoy crops like mustard upon which the insects gather and where they can be sprayed with pure kerosene to destroy them; (3) gathering of the adult insects and the destruction of the eggs by hand; and (4) spraying the insects after or during molting with strong kerosene emulsion, or whale-oil soap at the rate of 1 pound to 8 gallons of water.



**Cabbage worms.**—The imported cabbage worm and some other species of cabbage worms can be effectually controlled by the use of (1) Paris green at the rate of 1 pound to 50 gallons of water or (2) arsenate of lead at the rate of 4 pounds to 50 gallons of water sprayed on the young plants before the heads are well formed. This treatment should be repeated from time to time as required in order to protect the plants. Where a few plants are to be treated insect powder or pyrethrum is sometimes employed for the control of the insect by dusting it upon the plants.

**The cabbage aphid.**—Cabbage aphides or "lice" are controlled by the use of contact insecticides such as kerosene emulsion or whale-oil soap or other soaps.

Kerosene-soap emulsion is prepared by combining 2 gallons of kerosene, one-half pound of whale-oil soap, or 1 quart of soft soap with 1 gallon of water. The soap is dissolved in boiling water and then poured while still boiling hot (away from the fire) into the kerosene. The mixture is then churned rapidly for about five minutes, pumping the liquid back upon itself by means of a force pump and direct-discharge nozzle throwing a strong stream. At the end of this time the mixture will have become of the consistency of thick cream. Properly prepared, an emulsion will keep almost indefinitely, and should be diluted only as needed for use. For most species of aphides the staple emulsion should be diluted with from 10 to 20 parts of water. In the preparation of kerosene emulsion a force pump is a necessity, since if not made according to directions a perfect emulsion is not formed.

#### DISEASES.

Among the field troubles to which the cabbage is subject none is of greater economic importance than clubroot. This disease is peculiar in its method of attack and in the way in which it perpetuates itself. The chief danger with this disease arises from the fact that either the seed bed or the field may be infected and thus contaminate the crop. There is a danger then in purchasing plants. Infected plants purchased from a clubroot seed bed might be the means of contaminating one's cabbage land with the disease. Clubroot is a persistent malady. It will remain in the soil for five to seven years. Land so infected should not be used for cabbage, turnips, rape, mustard, or any other plant of the cabbage family. The rotation of crops to the exclusion of all cabbagelike plants for a term of years is the only safe way of ridding the land of the disease. This applies with equal force to both seed bed and field.

Cabbage plants should never be grown in a seed bed from which plants showing clubroot have been taken, and a field producing cabbage with clubroot should not be replanted in cabbage for at least seven years. This indicates the importance of using every known precaution against the introduction of this disease. There is no satisfactory remedy known except the following "Don'ts":

- (1) Don't sow cabbage seed on soil infected with clubroot.
- (2) Don't plant plants grown in a clubroot-infected seed bed.
- (3) Don't use manure containing roots of cabbage infected with clubroot on ground intended for the culture of cabbage or any of its close relatives.
- (4) Don't plant cabbage on an infected field within six or seven years after a diseased crop has been harvested.
- (5) Don't grow turnips, rape, mustard, or other cabbagelike plants on clubroot-infected soil unless you wish to perpetuate the disease.

Among the diseases which are at the present time causing considerable annoyance to cabbage growers is one of a physiological

nature which has been brought about by improper handling of the soil. This trouble, it is believed, is chiefly due to the fact that excessive quantities of mineral fertilizers have been used in a system of farming which has not provided a proper rotation. The result is that the organic matter, which is naturally very low in these soils, has been used up and is not present in sufficient quantity to counteract or neutralize the effect of the mineral fertilizers. The result is that the plants are practically starved to death in the presence of an abundant food supply on account of the fact that it is not presented in the proper form. Investigations now under way in the Bureau of Plant Industry clearly indicate this to be the case, and from what we know of the value of organic matter, such as stable manure and green crops turned under in other agricultural operations, it is

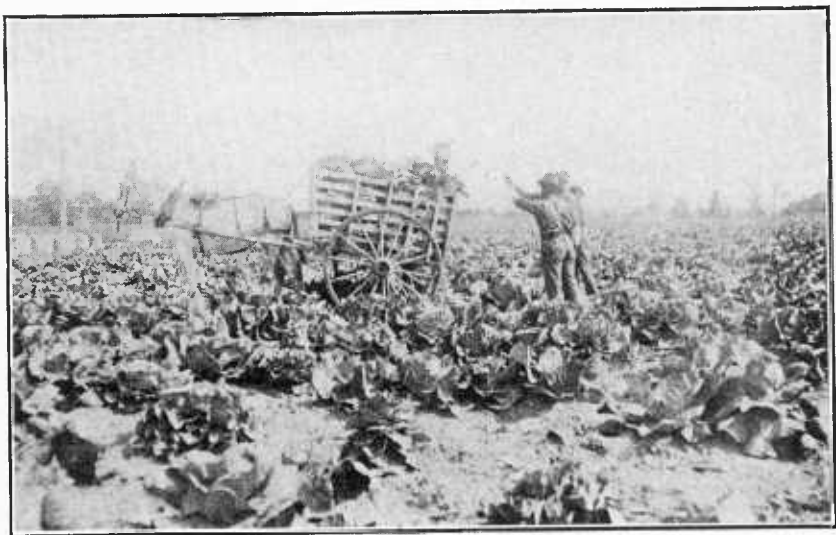


FIG. 3.—Harvesting cabbage near Portsmouth, Va.

reasonable to suppose that the benefits which have come from proper crop rotation in other localities will be equally as great in the trucking region.

#### HARVESTING.

Cabbage which is grown as a truck crop is harvested as soon as it has attained sufficient size to be placed upon the market, regardless of its stage of maturity. The first shipments of cabbage from the trucking regions consist of very small, immature heads, often with many loose leaves upon them. As the season advances, the quality of the product improves until the heads are very closely trimmed and carefully packed. The customary practice is to drive a horse and cart in charge of a gang of harvesters across the field. Each man follows two or three rows, according to the stage of development of the cabbage, with a strong knife cuts all sufficiently developed heads from the rows as he passes, and tosses them into the cart, as shown in Figure 3. The harvested heads are packed either in crates or in

barrels according to the locality in which they are grown. Cabbages from the Florida and Charleston region are largely shipped in crates similar to those shown in Figure 4, while cabbages from the Norfolk area are extensively packed in ventilated barrels similar to those shown in Figure 5, although a considerable proportion of the crop from this region is packed and shipped in crates.

#### VARIETIES.

The varieties of cabbage used in the trucking section are practically limited to the Wakefield type. There are two strains of this type of cabbage now extensively employed: The true Jersey Wakefield, with its small, acutely pointed tip and very firm, tender flesh of high quality, and the Charleston Wakefield, which is broader, somewhat flatter, more obtusely pointed, and slightly more angular in

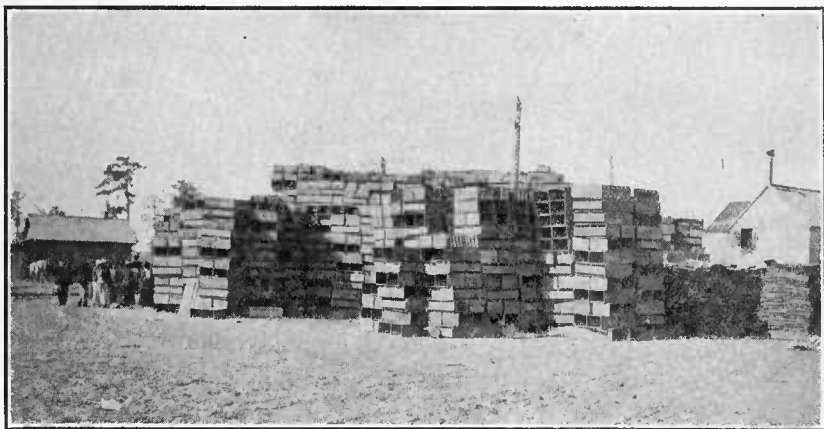


FIG. 4.—The type of cabbage crate used in the Charleston area.

cross section than the Jersey type. These two strains of cabbage are well illustrated in Figure 6.

#### MARKETING.

Cabbages from the trucking region are chiefly marketed in carload lots. Long-distance shipments of truck crops of all classes are most economically handled in this manner; in fact, it would be impossible to carry on the trucking enterprises of the country on their present scale unless it were possible to ship such commodities in carload lots.

The truck-crop cabbage business is at present chiefly conducted on a commission basis, although in a few sections crops are grown under contract. Owing to the perishable nature of early cabbage, it is probable that the crop will always be extensively handled on commission.

An item that should be considered by the grower of early cabbage for the northern markets is the quantity of cabbage placed in storage from the northern fields. A short crop of late cabbage at the North

means good prices for early southern-grown cabbage. Low prices and heavy storage of the northern-grown fall cabbage usually mean low returns for early southern-grown cabbage. The importance to the southern truck farmer of keeping close tab on the hold-over crop of the North in order that he may not be the loser is obvious.

## **CABBAGE AS A MARKET-GARDEN CROP.**

### **EXTENT OF PRODUCTION.**

Cabbage is a crop which is grown by every market gardener located within wagon-hauling distance of an important center of consumption. The statistics of the distribution of the cultivation of cabbage clearly indicate the fact that this is one of the impor-

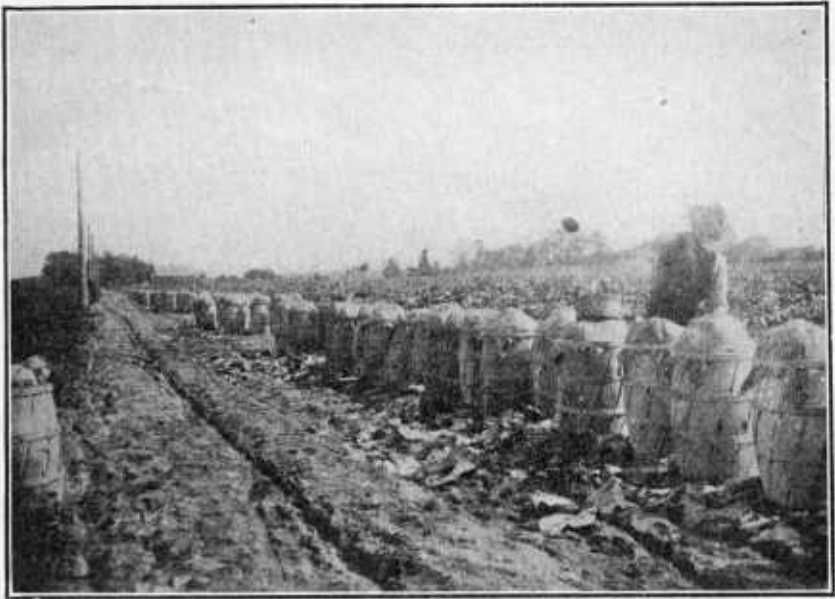


FIG. 5.—Cabbage barrels used in the Norfolk-Portsmouth region.

tant crops grown by market gardeners. The counties near each of the important centers of population of the United States are almost universally credited with a considerable acreage of cabbage, thus showing that the gardeners of these regions have given considerable attention to the production of this crop.

### **SOIL.**

The soil for cabbage must necessarily vary in different localities. In one area it may be of an alluvial character, while in another it may be sedentary, and in still another it may be characteristic glacial drift. The fact that cabbage grows well in all these soils indicates its adaptation to a wide range of conditions. The main thing with cabbage is an abundant supply of immediately available plant food. Market gardeners rely chiefly upon stable manure for their sup-

ply of plant food. Fertilizers also form an important item in the expense of producing cabbage as a market-garden crop, the quantity used depending upon the quantity and character of the supply of stable manure. The fertilizers chiefly used carry a liberal percentage of available nitrogen in the form of nitrate of soda or sulphate of ammonia (often as much as 4 or 5 per cent), 6 to 8 per cent of phosphoric acid, and 8 to 10 per cent of potash. As a result of the wise use of manure and fertilizers the soils of the market-gardening zone around any city or large town rapidly improve in fertility, and the gardener is able to grow a greater variety and larger quantities of products.

In the truck-farming area a few special crops are grown on a very extensive scale, while in market-garden regions a great many crops are grown in succession on a comparatively restricted area. Truck farming is in reality extensive market gardening, while market gardening is the most intensive form of farming. It is the practice of many market gardeners to plant coarse-growing, long-season crops far apart and to interplant one, two, or even three short-season, quick-maturing crops between them, or a quick-growing, short-season crop may be planted and between the rows a crop requiring a

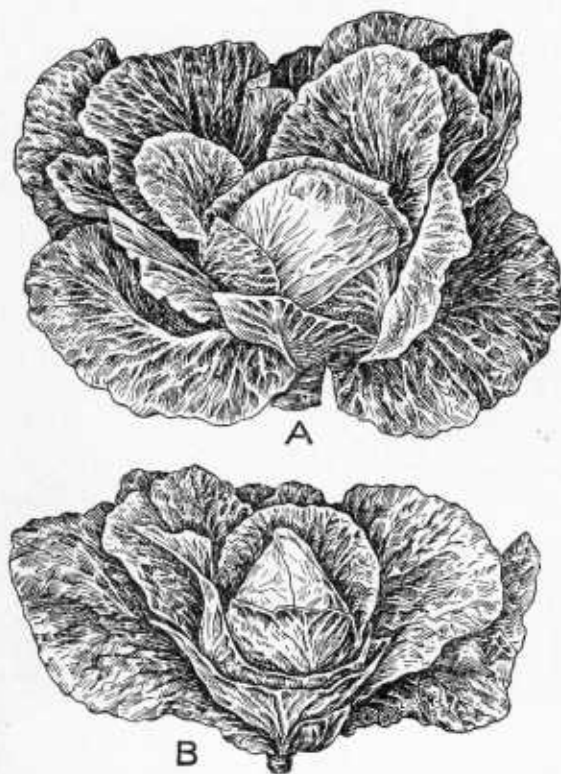


FIG. 6.—Wakefield strains of cabbage: A, Charleston Wakefield; B, Jersey Wakefield.

longer season, so that as the quick-growing crop is harvested the whole area is given up to the longer season crop. Cabbage is frequently made the basis of such a combination. Sometimes lettuce and radishes are grown between the rows of cabbage. Sometimes cabbage is planted between the rows of early beets, while late potatoes are frequently planted between the rows of early cabbage. The various combinations of such crops are too numerous to be catalogued.

#### YOUNG PLANTS FOR THE MARKET GARDEN.

The preparation of cabbage plants for the use of the market gardener in the North is a different matter from growing plants for use

on a truck farm in the South. The market gardener at most grows only a few thousand heads. The seed for these can be sown on an area covered by a hotbed or coldframe sash. The extra-early crop is either started in the open in September and transplanted to a cold frame as the frosty nights come on, to be protected through the winter by sash and shutters and transplanted to the open as soon as the ground can be worked in the spring, or the plants may be started in a hotbed from the 1st of February to the middle of March, depending upon the locality, and hardened off as the days grow milder by lifting the sash.

Plants grown and hardened off in this way are nearly as hardy as coldframe wintered plants. They can with safety be transplanted to the open as soon as the condition of the soil will warrant. As a rule, hotbed-grown plants do not head as quickly as wintered plants; on the other hand there will be fewer plants that shoot to seed. The grower will therefore use the plan best adapted to his cropping system, and may employ both plans in order that the peculiarities of the seasons may be most advantageously met. In some seasons the wintered plants give best results, while other seasons seem to favor the hotbed product. The use of both plans will safeguard the crop to the greatest degree.

#### SETTING PLANTS IN THE FIELD.

The cabbage plants are usually set in the field in rows about 30 inches apart and 13 to 18 inches apart in the row. For the extra-early crop the Jersey Wakefield is extensively employed. A later variety may be sown in the hotbed at the same time and the plants given similar treatment, but since the late sort requires a longer season it will form a succession with the Wakefield, enabling the gardener to maintain a continuous supply up to the time when he can utilize the crop grown from seed sown in April or May in the open, the plants of which are usually transplanted in the latitude of New York to the open field from June 20 to July 1. This crop provides the fall supply of cabbage for the market, and when treated as a field crop is used by the sauerkraut factories and the storage houses, and is marketed in carload lots in the southern cities and towns where extensive manufacturing enterprises are conducted.

#### CULTIVATION.

Among market gardeners it is a common expression that "cabbage should be hoed every day." Perhaps no other crop responds more quickly to good cultivation and an ample food supply. This is undoubtedly the explanation of the above quoted expression. In cultivating cabbage the work should be frequent and thorough, but the cultivation should not be deep. The aim should be to destroy all competing weeds and to maintain a loose, friable layer of soil about 2 inches deep over the surface of the area devoted to cabbage.

#### HARVESTING.

The early cabbage which is grown by the market gardener is cut, carefully trimmed, and marketed from his wagon or stall. The later crop which is harvested in the fall may not be marketed immediately, but may be stored temporarily in a cool, well-ventilated

building, in which case the heads are usually cut from the stalks, carefully trimmed, and stored in small bins or on shelves. If such facilities are not available an area on a well-drained portion of the field is prepared for the storage of the cabbage. The preparation usually consists in leveling an area wide enough to allow about five heads of cabbage to be placed, roots up, in a continuous row or belt, as suggested in Figure 7. The outer leaves are all preserved and carefully wrapped around the heads as they are placed, after which the whole is covered with a layer of straw or marsh hay and, as the weather increases in severity, with a slight layer of earth. In the milder portions of the country this protection is employed for the whole winter. Farther north the soil layer must be increased, and where winters are severe storage houses should be used rather than this primitive method of storing.

If the crop is to be stored on a more extensive scale it may be placed on a ventilated platform and piled in long ricks, as suggested in Figure 8, and then covered with rye straw and a layer of earth.

#### VARIETIES.

The varieties of cabbage used by market gardeners include not only the Jersey Wakefield for extra early, but a variety of the early-



FIG. 7.—Method of storing cabbage on a small scale at the North.

summer or sure-head type for the midseason, with some of the Flat Dutch sorts as the main fall crop.

### CABBAGE AS A FARM CROP.

#### RANGE OF CULTURE.

Cabbage finds its most congenial habitat as a farm crop in the northern tier of States, including those bordering on the Great Lakes, the New England States, and to a less extent in Kentucky, Tennessee, and Missouri. New York grows almost three times the acreage of any other State as a farm crop. It is this farm crop of cabbage which finds its way to the sauerkraut factories, to the cities of both the North and South as the cool days of fall and early winter come on, and to the large storage houses distributed through New York and Wisconsin.

#### SOIL.

The soil upon which cabbage is most extensively grown in this region is either rich alluvial bottom land or the rich prairies of the States west of New York and Pennsylvania. Cabbage is a bulky

product and usually does not sell for a very high price per ton, but the large tonnage produced per acre and the fact that it is consumed by all classes account very largely for the extensive acreage grown throughout the area of dense population.

#### PREPARATION OF THE LAND.

Where grown as a farm crop cabbage is used as one of the factors in a crop rotation for the farm and may be made to occupy a portion of the clover sod turned down in the year when clover is turned under to provide for other crops. A common rotation is to use corn, followed by oats with which clover is sown. The clover is cut one season and turned under the following spring, the area being devoted to cabbage and potatoes. The clover sod is supplemented by a heavy dressing



FIG. 8.—Method of piling cabbage for storage over a board-covered trench, to allow ventilation when earth is used for protection.

of stable manure on the portion to be devoted to cabbage. If manure is not available the necessary supply of plant food is made up by the use of a high-grade fertilizer carrying  $3\frac{1}{2}$  or 4 per cent of nitrogen, 6 or 8 per cent of phosphoric acid, and 8 to 10 per cent of potash, applied at the rate of 500 to 1,000 pounds to the acre.

#### STARTING THE SEEDLINGS.

When cabbage is grown as a farm crop the seed bed is prepared in the open in a sheltered place. In the latitude of central New York seeds are sown in the open early in May. The young plants are kept free from weeds and should be ready to transplant to the field about June 20.

The choice of the site for the seed bed may determine the success or failure of the whole enterprise. The vigor of the plants and their



freedom from disease are factors of prime importance. The seed bed should, therefore, be located only on areas known to be free from clubroot and rot organisms. Areas where cabbage has been grown or where cabbage plants have been propagated in previous years are to be avoided, as are also manures containing cabbage refuse. The manure from stalls or pigsties where cabbage has been fed is to be avoided on account of its liability to carry clubroot and rot organisms.

#### SETTING THE PLANTS IN THE FIELD.

In some localities it is customary to set the plants in checkrows about 30 inches apart each way, so that they can be cultivated in both directions. In other sections the plants are set in rows one

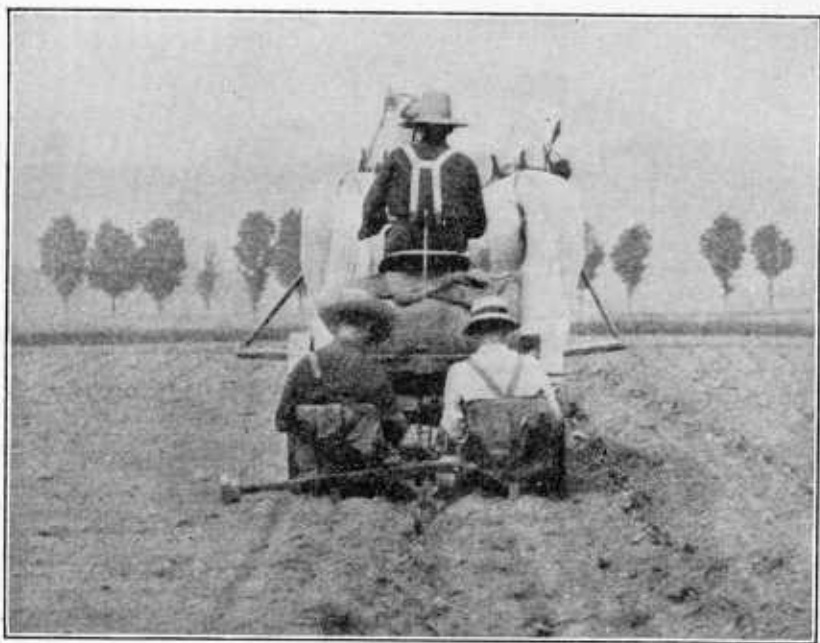


FIG. 9.—Transplanting machine in operation.

way only, and are placed 18 to 24 inches apart in the row. With the large-growing late sorts, however, 30 inches between the plants in the row is not too much space. If the transplanting is to be done by hand it will be performed by puddling the plants and setting them with a dibble. If carried on very extensively the work can, as a rule, be more economically done by utilizing one of the horsepower transplanter, such as is shown in Figure 9, in which case the plants are frequently set about 20 inches apart in the row and cultivated in one direction only. Painstaking growers, however, mark the field 30 inches apart in one direction and drive the plant-setting machine at right angles to these marks, thus enabling the setters to place the plants in checkrows 30 by 36 inches apart. This plan has the advantage of placing the plants at better intervals and permits of cultivation in both directions early in the season.

As soon as the plants have been set in the field, cultivation is started and kept up with suitable implements, depending upon the size and character of the plants, until the cultivator can no longer be run between the expanded leaves of the crop. Attention from this time on is necessary to protect the crop from insect enemies, such as the cabbage worms and the aphides or "lice." (See p. 5.)

#### HARVESTING.

At harvest time, whether the cabbage is to be shipped, carried to the sauerkraut factory, or stored, a wagon provided with a very deep body is driven across the field, the heads of two rows having been cut and laid at one side in advance of the team. Men accompany the team and gather the heads which have been cut, carefully trim them and gently toss them to a person in the wagon, who loads them with equal care. Heads intended for long shipment or for storage should be very carefully handled, so as not to bruise or in any way injure them. In unloading to the car or storage house the same precautions in careful handling should be observed as in gathering from the field.

#### VARIETIES.

The varieties which may be used for field cultivation depend upon the purpose for which the cabbage is intended. If for sauerkraut or for immediate consumption, the Flat Domestic type such as All Seasons is extensively employed in the eastern part of the United States. In the irrigated section of Colorado, in the vicinity of Greeley, where cabbage is grown for sauerkraut, a variety known as Scotch Cross is almost universally grown.

If the cabbage is intended for storage the Danish Ball Head from imported seed is almost exclusively used.

#### STORAGE.

The prerequisites for the successful storing of cabbages are: (1) Carefully grown and carefully handled heads of a sort well adapted for storing; (2) storage warehouses so constructed and arranged as to prevent drip from the ceiling or roof striking the stored heads; and (3) such an arrangement and control of the ventilation and temperature of the building as to prevent the condensation of moisture on the cabbage while in storage.

The Danish Ball Head from imported seed, as has been stated, is the variety chiefly grown for storage purposes. The heads should be very carefully cut and closely trimmed so that no loose leaves get into the storage house. In hauling cabbage from the field to the storehouse, spring wagons should be used and the heads should be passed from hand to hand and never thrown into the wagon body. The same care should be observed in placing the heads in storage.

The general type of construction employed in commercial storage houses is that of a broad, low house with an alley sufficiently wide to admit a team and wagon through the center, and with the storage bins or shelves arranged on either side.

For farm storage the type of house illustrated in Figure 10 is very satisfactory. There are no walks or driveways in this house, and

therefore no waste space. At storage time the cabbages are received through the windows, and they may be discharged either through the windows or through the door. If the heads are to be stored in bins, the bins should be narrow and not more than 16 or 18 feet from front to back, and the heads not more than 6 or 7 feet in depth in each bin. Several bins may be placed one above another in the same section by placing a waterproof flooring between the bins, so that the drip caused by decaying cabbage or other condensation can not reach the lower bin from the one above. This plan of storage is not, in general, as satisfactory as to store the cabbage on shelves, as shown in Figure 11. As is suggested in the figure, the heads may be stored in single layers or in layers two or three deep on the shelves.

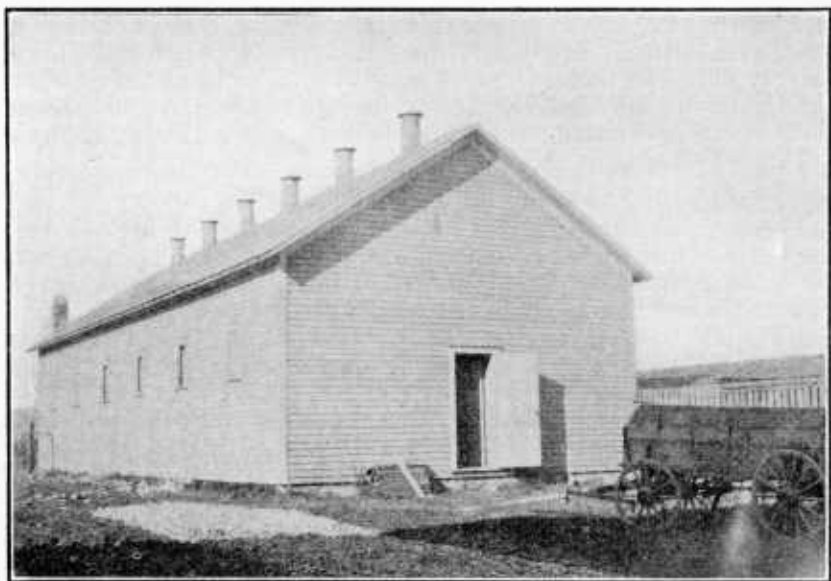


FIG. 10.—Frost-proof storage house for cabbage on a New York farm.

Precautions should be taken to provide an area way between the outside wall of the building and the storage bins or shelves.

The walls of the building should be so made as to provide a dead-air space to prevent the penetration of frost. If the walls are made of brick, two 4-inch walls could be laid up and tied by a header course, so as to provide an air space 2 or 3 inches wide between the two walls; or a solid 9-inch wall may be constructed and either a tongue-and-groove wall or a lath-and-plaster wall placed on the inside by the use of furring strips. The roof should be provided with a suitable outer covering, either of shingles, of steel, or of composition, and should have an inner lining so built as to provide a dead-air space. If the inner lining is made of lumber the boards should run parallel with the rafters rather than at right angles to them, so that condensation may flow to the eaves rather than fall from each joint. Exits for warm air should be by means of ample ventilators along the ridge, provided with dampers, which can be controlled by ropes

extending to the passageways. Cold air from the outside can be admitted through apertures in the foundation by means of large terra-cotta pipes provided with wire netting over the outer end and suitable dampers or shutters on the inside, so that the intake of air can be controlled.

The secret of success in the management of a storage warehouse is to have disease-free, well-matured, firm, carefully handled stock grown from high-grade seed and the storage house so constructed that the temperature can be lowered and maintained as near  $34^{\circ}$  F. as possible throughout the whole storage period. This means that the greatest care must be exercised to take advantage of cool, frosty nights which occur during the storage period, and as soon as the house is filled to keep it closed during the day and open as much as possible during the

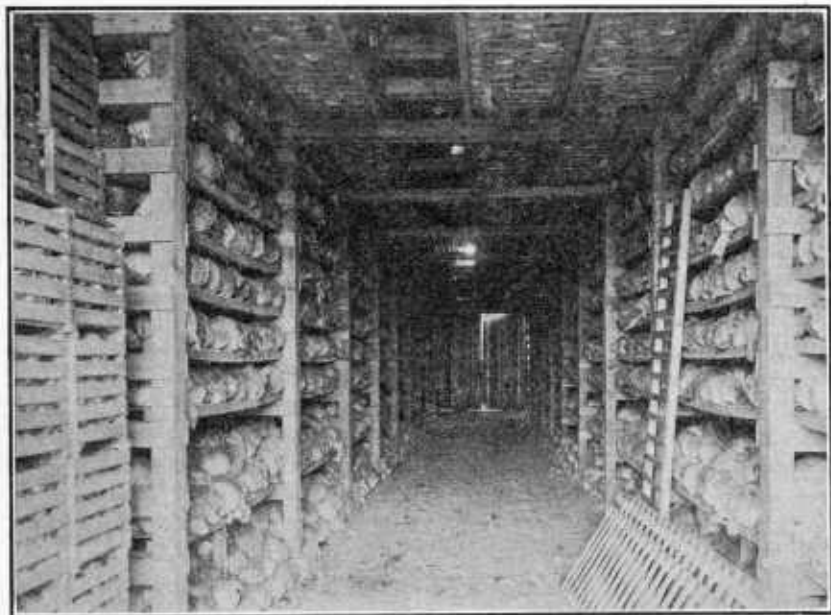


FIG. 11.—Interior arrangement of a cabbage storage house showing the method of placing the heads on the shelves.

night so as to get the benefit of the low night temperatures. The other extreme of too low temperature should also be provided against. During protracted cold spells the temperature inside the storage house may get dangerously low. To guard against loss from freezing, oil heaters are placed at suitable intervals in the walks and alleys to maintain the temperature above the danger point.

Storage troubles are more largely the result of careless handling and bad ventilation than of diseases. Practically all of the rotting which takes place during the storage period is the result of saprophytic organisms attacking the badly handled or slightly diseased heads under bad storage conditions. Poor cultivation, bad harvesting methods, a long haul to storage, and rough handling in unloading and storing are all to be avoided if cabbage is to be kept successfully through the storage period.

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